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CURRENT ACTIVITIES

ATLANTIC PROVINCES

The Relation Between Spruce Budworm Egg-Mass Numbers and Defoliation the Following Year in Sprayed and Unsprayed Areas.—Spruce budworm hazard and the need for spraying in New Brunswick are determined from annual surveys of defoliation and damage and from egg-mass counts to assess the likelihood of defoliation the following year. Since 1954 the prediction of probable degree of attack has been based on the following regression: probable percentage loss of new growth $= 0.27x + 5.8$ where $x =$ No. of egg-masses per 100 sq. ft. of mid-crown branch area. Coefficient of correlation is 0.82. This was computed by D. G. Mott from data accumulated from several sources (principally the Forest Insect Survey), all of which were obtained from unsprayed areas.

Studies of the results of aerial spraying show that the best recovery of foliage growth commonly occurs the year following treatment and that defoliation is frequently less than expected on the basis of the above regression. The possibility that this is the result of mortality of some of the newly-hatched larvae due to residual toxicity on the branches has been tested in a limited way by Smith with inconclusive results (Bi-Monthly Progress Report 11(2), 1955). Attempts have been made from time to time to compute a revised defoliation/egg regression to apply in sprayed areas but without success. This is owing to the lack of any consistent correlation between these variables. The data available to date consist of some 56 pairs of estimates in which egg-mass counts occur chiefly in the moderate and moderately high categories. However, the average loss of new growth of these plots was 57 per cent from egg populations averaging 222 masses per 100 sq. ft. In unsprayed areas the expected defoliation from this number of eggs would be 66 per cent. Lacking a more precise regression, predictions of the degree of probable attack the year following spraying are still made on the basis of the unsprayed condition. Since these sometimes prove excessive this alternative has the merit of reducing the chances of underestimating hazard.—F. E. Webb.

Decay of Storm-Damaged Conifers in New Brunswick.—As the result of a severe ice storm in January, 1956, large numbers of trees in northern New Brunswick have broken tops which provide infection courts for wood-decaying fungi. In 1957, studies were begun to determine the nature and rate of the decay entering through broken tops in coniferous trees. During August, 38 balsam fir and 16 spruce, 5 inches or less in diameter, were felled and examined for decay. Decay was found to have entered through the broken tops of all trees examined. In balsam fir, the extent of the decay from the break into the trees varied from 1 inch to 32 inches, with an average of 8 inches. The decay in spruce extended from less than 1 inch to 29 inches into the trees, with an average of 11 inches. Although all the fungi isolated have not been identified, it is apparent that *Stereum sanguinolentum* Alb. & Schw. ex Fries is the fungus most commonly entering the damaged trees. It was obtained in culture from decays in 34 of the 38 balsam fir examined and in 12 of the 16 spruce.—W. R. Newell.

ATLANTIC PROVINCES AND ONTARIO

A Moth Attacking Larch Shoots in Eastern Canada.—*Argyresthia laricella* Kearfott is an yponomeutid moth, the larva of which bores in the terminal shoots of *Larix*. It was described from specimens taken on *L. laricina* (Du Roi) K. Koch at the Mer Bleue bog near Ottawa in 1907 by Kearfott (J. New York Ent. Soc. 15: 182, 1908). It was apparently not noticed again until June, 1955, when T. N. Freeman collected it in considerable numbers in the same bog (private communication).

A. laricella was found by the Forest Insect Survey in many localities in Ontario in 1956 and 1957, and New Brunswick in 1957. In the latter area it was collected on *L. laricina* in ten of fifteen counties indicating a province-wide distribution. In the former province the insect was collected generally in those parts of Ontario south of Lake Nipissing and between Lake Nipigon and the Manitoba boundary. It was also taken near Kirkland Lake, Geraldton, and Sault Ste. Marie. All the Ontario records were from *L. laricina* except one from St. Williams on Lake Erie, which was from *L. decidua* Mill. There is but one record from Nova Scotia; eight adults, determined by J. McDunnough, were taken on St. Paul Island in the Cabot Strait in July, 1955 (Ferguson, D.C., private communication). No collections are known to have been made in other provinces.

Little is known of the seasonal history and habits of this insect. The eggs are laid in early summer, probably on the outside of the new shoots. The larva mines 3 to 6 inches of the apical end of the new shoot, overwinters in the gallery and resumes feeding in the spring. Before pupation it chews a circular hole at the lower end of the gallery, through which the adult later emerges. The time and duration of pupation is uncertain, but apparently healthy larvae were collected in New Brunswick as late as June 6 and adults emerged from field collected pupae from June 16 to July 17. In the most southerly part of Ontario adult emergence occurred through the last week of May and the first three weeks of June; elsewhere in Ontario in June and early July.

The mined part of the shoot at first bears abnormally short needles, but by the second season this portion is dead and later in that season may break off at the exit hole. Consequently, infested shoots are most easily found in the spring. A related species, *A. laevigatella* Herrick-Shäffer, causes similar damage to larches in Europe (Escherich, K. Die Forstinsekten Mitteleuropas, Vol. 3, 1931, Paul Parey, Berlin).

Eleven species of parasites were reared from *A. laricella* in New Brunswick and Ontario. These were identified as follows by the Systematic Entomology and Biological Control Unit, Entomology Division:

Ontario 1956—*Apanteles* n. sp. near *petrovae* Walley
Apanteles prob. *rohweri* Mues.
Colastes sp.
Gelis obscurus Cress. probably hyperparasite on *Apanteles*.

Ontario 1957—*Alegina* n. sp. probably hyperparasite on *Apanteles*.
Apanteles n. sp. near *petrovae* Walley.
Bracon n. sp. near *auripes* Prov.
Calliephialtes comstockii (Cress.)
Habrocytus sp.
Pimplopterus sp.

New Brunswick 1957—*Habrocytus* sp.
Phaeogenes n. sp. near *epinotiae* Cushman.
Spilochalcis albifrons (Walsh).

In New Brunswick, *Apanteles* n. sp. near *petrovae* Walley, and *Pimplopterus* sp., were found as adults or pupae in the collecting containers with *A. laricella*, and since no other possible hosts were known to be enclosed they are probably valid parasite records.

Apparently this insect, which is capable of causing considerable damage to its host, has occurred unnoticed in eastern Canada for many years. In 1955, T. N. Freeman found that 75 per cent of the twigs of many trees had been killed at the Mer Bleue bog. Reports received in 1956 and 1957 in Ontario indicate that this degree of damage was extreme and by no means represents the generally low population level found in eastern Canada. The authors plan to study the bionomics and morphology of the immature stages of this insect.—D. C. Eidt and W. L. Sippell.

QUEBEC

Status of the Spruce Budworm in Lower St. Lawrence and Gaspé, and Results of Spraying Operations—1957.—During the past few years spruce budworm populations attained epidemic proportions in all parts of the Gaspé

Peninsula and in the eastern sector of the Lower St. Lawrence. Prior to 1957, populations persisted at a high level in unsprayed areas, while sprayed areas were gradually re-invaded. In 1957, in the region of the Shickshock Mountains in Matane and Gaspé Nord counties, the outbreak collapsed over a territory of 1,600 square miles representing approximately 20 per cent of the affected region. The collapse was attributed to the cool temperatures in the spring and summer of 1956, that prevented the insect from completing its life-cycle. (Bi-Monthly Progress Report 13 (1) 1957). In the spring of 1957 population samples taken at the time of the third instar from five 18-inch branch tips from each of the 23 localities in the region of the Shickshock Mountains indicated an average population of less than four larvae per 18-inch branch. At the time of the pupal stage in July, the population in the same region was further reduced to an average of 0.2 insects per 18-inch branch tip.

Elsewhere in the Peninsula, populations were abundant in the spring. At the time of the third instar there was an average of 34 larvae per 18-inch branch tip in samples obtained from 56 unsprayed localities. However, the decline due to natural factors between the time of the third instar and the pupal stage was somewhat higher than in past years; samples taken at the time of the pupal stage gave an average of 3 insects per 18-inch branch. The increase in natural control was largely attributable to the action of several diseases caused by bacteria, fungi, and microsporidia. Infection by these agents is nearly always present in spruce budworm populations, but the wet weather that prevailed in 1957 offered ideal conditions for the spread of disease. Diseased sixth-instar larvae and pupae were found throughout the territory, but were especially abundant in the eastern region.

An egg survey was conducted under the direction of R. Martineau, very much as in past years. Results of the survey, when compared with those of other years, indicate a considerable reduction in egg population, especially in the western and northern sectors of the territory. In 1955 and 1956, between 50 and 75 per cent of the samples taken in unsprayed localities showed heavy populations of eggs, whereas in 1957, only 30 per cent of the unsprayed localities sampled for eggs showed heavy populations. In the Matane and Gaspé Nord counties the scarcity of eggs was no surprise, since in this region larval populations had been very low throughout the season. In much of the remaining territory, however, the reduction in eggs was not in accord with the earlier larval populations. Quite often in areas where defoliation of the current year's growth was severe, indicating that larval populations had been high, the ensuing egg population was low. It is probable that the disease referred to above that attacked sixth-instar larvae and pupae was to some extent responsible for this reduction.

The current year's spraying operation covered 1,255,000 acres and was the most extensive to date. All airstrips built for previous operations, with the exception of Farm Lake, were utilized. In addition, two new airstrips, Lesseps and Pabos were built, and existing commercial airfields at Rimouski and Gaspé were utilized. Application of the sprays started on June 13, five days earlier than in 1956, but because of unsuitable weather was not completed until July 5, four days later than the previous year.

Results of the operations are based to a considerable degree, on a post-spray survey conducted at the time when approximately 50 per cent of the pupae had emerged. Population and defoliation estimates were made in 221 sprayed and unsprayed localities. The study area may be divided into three fairly distinct regions with respect to budworm populations and results of spraying operations. In the Western - South Central Region which encompasses Rimouski, Matapédia, and Bonaventure counties, the 1957 operations were responsible for saving 30 per cent of the 1957 foliage and for reducing the insect population by 91 per cent. In the North-Central Region which includes Matane and Gaspé Nord counties, no insects were found in localities sprayed in 1957, and populations were very low in other localities. Defoliation of the current year's growth was light almost everywhere. The Eastern Region which includes Gaspé Sud County was sprayed for the first time. In the spring, insect populations were exceedingly high throughout this area and counts of over 250 larvae per 18-inch branch were made along the Pabos River. Results of the post-spray defoliation survey indicated that relatively small amounts of the current year's growth were saved, despite a population reduction of 61 per cent attributable to spraying.

Generally, in areas sprayed in 1956, insect populations were low and the trees showed good recovery in 1957. Areas treated prior to 1956 were re-invaded in 1957 and differed little from untreated areas with respect to defoliation of the 1957 shoot growth.

Although the infestation has declined over a considerable part of the territory in 1957, it does not necessarily follow that it is coming to an end. The present situation appears to be the result of the unfavourable weather of the past two summers, and may be only temporary. There still remain fairly extensive areas where spruce budworm populations are high and an area of approximately 800,000 acres will require treatment in 1958 in order to keep the trees alive.—J. R. Blais.

PRAIRIE PROVINCES

The Effect of O-Phenylphenol on the Growth of Some Wood-rotting Fungi.—Russel reported on the use of a medium for isolating wood-rotting fungi from wood pulp (Russel, P. A. selective medium for the isolation of basidiomycetes. Nature 177: 1038-1039. 1956.). This contained o-phenylphenol to retard fast-growing moulds, especially *Trichoderma viride* Pers. ex Fr. Basidiomycetes grew, although slowly, in medium containing up to 0.01 per cent o-phenylphenol. *Merulius lacrymans* Jacq. ex Fr. was the only fungus encountered which failed to grow on the medium.

In decay studies of white and black spruce, cultures of wood-rotting fungi are frequently overrun by fast-growing moulds which prevent their isolation and identification. o-Phenylphenol was tested as a means of retarding hyphomycetes that occur in wood. Small chips of wood were removed aseptically from samples of decay in black spruce and plated on slants of Difco malt agar containing 0.006 per cent o-phenylphenol. The results were as follows:

—	Number of samples	
	Tested	Successful isolations
Brown cubical decays	16	1
White pocket decays	22	21
Yellow stringy decays	11	5
Brown coloured decays	2	2

The number of cultures from the white pocket, yellow stringy, and brown coloured rots were about normal, considering the condition of the decays, but the brown cubical rot should have yielded a much higher number of cultures. The one fungus isolated from the brown cubical decays was *Fomes pinicola* (Sw.) Cooke. The samples which failed to yield cultures appeared from the characteristics of the decay, to be infected by *Coniophora puteana* (Schum. ex Fr.) Karst. Most of the tubes were sterile but some showed slight growth on the inoculum. Transfer of these inocula to malt agar yielded only hyphomycetes.

Because o-phenylphenol completely inhibited the growth of at least one species of the fungi causing brown cubical decays, further tests on the effect of this chemical were carried out using a number of wood-rotting fungi from a stock culture collection. Stock cultures were transferred to slants of Difco malt agar and Difco malt agar containing 0.006 per cent o-phenylphenol. Cultures on the two media were examined and compared after one, two, and four weeks. If the cultures on the two media were similar, or if the only difference was a slower growth rate on the o-phenylphenol malt medium, they were not tested further. If the platings on o-phenylphenol malt agar remained sterile the test was repeated.

Growth of the following fungi on o-phenylphenol malt agar was similar to, though generally slower than, the growth on malt agar alone: *Fomes pini* (Thore) Lloyd, *Stereum pini* (Schleich. ex Fr.) Fr., *S. sulcatum* Bert., *Peniophora septentrionalis* Laurila, *P. gigantea* (Fr.) Massee, *Flammula alnicola* (Fr.) Quél., *Armillaria mellea* (Vahl ex Fr.) Quél., *Corticium galactinum* (Fr.) Burt., Unknown C, Unknown D, Unknown F, (Unknown C, D, and F are designations for unidentified wood-rotting cultures by Dr. M. K. Nobles, Botany and Plant Pathology Division, Science Service, Department of Agriculture, Ottawa), *Trechispora brinkmannii* (Bres.) Rog. & Jacks., *Trametes variiformis* Peck, *Omphalia campanella* Fr., *Fomes pinicola*, and *Trametes serialis* Fr. The last two fungi cause brown cubical decays. *Coniophora puteana, Polyporus balsameus* Peck, *P. sulphureus* Bull. ex Fr., and *Merulius himantioides* Fr., which cause brown cubical decays, and *Polyporus hirtus* Quél. which causes a yellow pocket decay failed to grow on medium containing o-phenylphenol. *Polyporus tomentosus* Fr. and *Stereum sanguinolentum* Alb. & Schw. ex Fr. varied on the o-phenylphenol medium; some cultures were almost identical to those on malt agar alone, while in others growth was much slower and the mat atypical. Cultures of these two fungi could, however, be easily identified from their microscopic characters.

To sum up: Russel found that *Merulius lacrymans*, the cause of a brown cubical decay, would not grow on a medium containing o-phenylphenol. In the present work several other brown cubical decay fungi were completely inhibited by the addition of o-phenylphenol to malt agar. One of these, *Coniophora puteana*, is one of the most important decay fungi in boreal white spruce. It is concluded therefore that the addition of o-phenylphenol in culture media, to retard

the growth of moulds, has limited use in the isolation of wood-rotting fungi from decayed wood in decay studies. Isolations from brown cubical decays would also have to be made on a medium lacking o-phenylphenol to ensure that cultures are not lost through sensitivity of the fungus to the chemical.—W. B. G. Denyer.

ROCKY MOUNTAIN REGION

***Nematodes Associated with the Mountain Pine* Beetle.**—Preliminary investigations of the nematodes associated with the mountain pine beetle in the East Kootenay region of British Columbia indicate the presence of at least seven species. These are listed in Table I. The identifications were made by Dr. M. A. Khan, formerly of the Nematology Laboratory, Entomology Division, Ottawa.

TABLE I

Species	Habitat
Sphaerularia hastata Khan	Digestive tract of adults Body cavity of adults Reproductive organs of adults Egg niches
Sphaerularia sp. (Juvenile stages)	Frass in main galleries
Ektaphelenchus tenuidens (Thorne)	Egg niches Frass in larval galleries Frass in main galleries
Aphelenchoides brachycephalus Thorne	Egg niches Frass in larval galleries Frass in main gallery
Cryptaphelenchus latus (Thorne)	Frass in main galleries
Aphelenchoides talonus Thorne	Egg niches Frass in main galleries Frass in larval galleries
Aphelenchoides sp. (Juvenile stage)	Digestive tract of adults
Panagrodontus dentatus Thorne	Egg niches Frass in main galleries
Diplogaster pinicola Thorne	Frass in main galleries

Sphaerularia hastata Khan was the most important nematode affecting the mountain pine beetle in the East Kootenay region of British Columbia during 1956. Large masses of the adult nematodes and their eggs were frequently found packed into the abdomen and thorax of the beetle. Very few nematodes occurred in the digestive tract but some were found in the reproductive system of one female beetle, Nematodes and their eggs occurred in loose formation in the vagina, and appressed to the walls of the median oviduct, but the largest number occurred in the bursa copulatrix. Heavily infested beetles can frequently be detected by their behaviour. Their movements are very lethargic and they do not attempt to escape when removed from the galleries. There are often noticeable tremors in the antennae and legs. Soon after these adults died, nematodes could be observed leaving the body of the host. They appeared to force their way through the sutures and between the sclerites of the abdomen.

Table II shows the effect of *S. hastata* on the number of eggs laid. The absence or presence of nematodes in conspicuous numbers was determined by dissecting the female beetles when they were removed from their galleries.

TABLE II

Condition of Adults	Number of Adults	D.F.	Mean No. of Eggs Laid per Gallery	Sum of Squares
Uninfested	87	86	56.9	347981
Infested	33	32	38.4	68822

R. W. Reid.

BRITISH COLUMBIA

Selection of Host Material by the Douglas-fir Beetle.—The problem of host selection by bark beetles is one that has received much attention. An understanding of reasons why bark beetles are attracted to certain trees, apparently similar to others that remain unattacked, would be a big step towards the development of methods to reduce the damage caused by these insects. The demonstration of selection presented here may offer some valuable clues.

During studies of the Douglas-fir beetle, *Dendroctonus pseudotsugae* Hopk., near Lumby and Lac la Hache, B.C., in May, 1957, forty-two 4-foot sections of Douglas fir were placed on end. Although nearby material lying on the ground was heavily attacked, the standing sections were attacked only lightly or not at all.

Consequently, two Douglas-fir trees at Lac la Hache were felled and bucked into 4-foot sections on May 30. Alternate sections were placed on end, while the remaining sections were left lying on the ground and rolled one-half turn each day to expose the entire bark area equally. Daily attack records were kept for each section for ten years. The total attack, summarized in Table 1, clearly shows that the beetles preferred the sections on the ground.

It was thought that possibly the standing sections drew moisture from the soil and that the sections on the ground dried faster, thus hastening metabolic changes within the logs which might influence the attraction of the beetles. Another theory was that the position of the log might affect the ease with which the attacking beetles could land.

The experiment was repeated on a smaller scale with six 4-foot sections from a tree felled on June 5. Three 4-foot sections were left lying on the ground and three were placed on end. The standing sections were placed on wooden blocks to keep them off the ground. The results were generally the same as those obtained from the first two trees, except that one of the standing logs was quite heavily attacked (8.48 per square foot). These data do not entirely support the landing-ease theory, although the results are not conclusive. A further possibility is that the sun's rays on the bark surface may produce greater heating in the logs on the ground and thus more readily release volatile substances which may attract the beetles.—M. D. Atkins and L. H. McMullen.

TABLE 1
DOUGLAS-FIR BEETLE ATTACKS ON 4-FOOT SECTIONS OF DOUGLAS-FIR LOGS DURING FIRST TEN DAYS AFTER FELLING ON MAY 30, 1957

Tree number	Attacks per square foot			
	Standing sections		Sections on the ground	
	Mean	St. deviation	Mean	St. deviation
1	0.32(5) *	0.26	7.80(5)	1.24
2	1.56(6)	1.00	6.57(7)	1.99

* Numbers in brackets indicate number of 4-foot sections.

Black-headed Budworm Control Project, British Columbia.—Populations of the black-headed budworm, *Acleris variana* (Fern.) showed signs of increase on the coastal areas of British Columbia in 1952. By 1954 heavy "spot" infestations on western hemlock were found at several points on the northern part of Vancouver Island. In 1955 about 1 million acres in this area showed signs of defoliation, much of it severe. The area infested increased to 2 million acres in 1956, of which 630,000 acres were severely defoliated. Egg surveys in the fall of 1956 showed that substantial defoliation could be expected in 1957 of about 155,000 acres of forest then already in poor condition from two consecutive years of moderate to heavy attack. Based on this information recommendations were made which resulted in a decision to spray these particular stands in 1957.

Because no previous spraying had been done against this insect, and anticipating that control operations might be required in 1957, about 240 acres of hemlock were sprayed experimentally in 1956 to obtain information on time of application and dosage of DDT required for effective control. This experiment was supported financially by several major coast logging companies and the British Columbia Forest Service, and was directed by officers of the Forest Biology Division.

In 1957 some 156,000 acres, mostly in the Englewood-Port Hardy-Port Alice triangle, were sprayed during the period June 10-20. About 146,000 acres were treated with the operational spray solution (DDT in oil solution containing an emulsifier applied at the rate of 1 lb. DDT per U.S. gal. of solution per acre). Five thousand acres were sprayed experimentally with diluted operational spray solution (0.5 lb. DDT per gal. per acre), and another 5,000 acres were sprayed with the full strength oil solution without emulsifier.

The operation was carried out by the British Columbia Loggers' Association and was directed by W.S. Hepher, Chief Forester, Alaska Pine and Cellulose Ltd. One-third of the cost was borne by the Federal Government, and the remaining two-thirds was shared between the Provincial Government and the B.C. Loggers' Association (acting on behalf of Alaska Pine and Cellulose Ltd., Canadian Forest Products Ltd., MacMillan and Bloedel Ltd., and Powell River Co. Ltd.) on an acreage basis. Spray deposit and biological assessment work was directed by two officers of the Forest Biology Division, K. R. Elliott of the Forest Insect Laboratory, Sault Ste. Marie, Ont., and A. P. Randall, Chemical Control Section, Ottawa. Damage to fish and fish food populations was assessed cooperatively by the Federal Department of Fisheries and the B.C. Game Commission. The aircraft for the spray job were four converted TBM Gruman Avengers operating under contract with Skyway Air Services, Langley, B.C.

Spraying was to commence when the budworm population had developed to the point where the majority of larvae were in the second instar and with the first and third instars about equally represented. This point was reached at elevations under 1,000 feet by June 10, but to allow for retarded development at higher elevations spraying did not commence above 1,000 feet until June 17.

Control achieved was determined by comparing insect populations in sprayed and unsprayed plots before and after spraying. Sampling of plots was discontinued on the twelfth day after spraying. Spray deposit was assessed from droplet stain patterns on dyed cards placed in sample plots, and also on or near all accessible logging roads, lakes and streams.

A number of circumstances made it difficult to obtain uniform and controlled spray coverage. Spray deposit data showed that a light to medium recovery would be indicative of the over-all spray deposit in the sprayed area. Deposits were lighter in areas skip-sprayed to avoid lakes, streams, cut-overs, and cedar swamps, and heavier where avoidance of specific landmarks was not required.

The operational spray solution effected complete control where coverage was adequate (medium or heavier). The indicated over-all control of about 90 per cent was sufficient to prevent serious defoliation in 1957. Results obtained with the diluted operational spray solution indicated that it was potentially as effective as the full-strength solution. Results with the diesel oil without emulsifier were inconclusive.

Although a number of measures were taken to minimize fish mortality, damage to fish and fish food populations was found to be severe on four of the several major streams assessed. The fish mortality was confined generally to coho fry, trout, steelhead yearlings and possibly alevins of both trout and steelhead.

About 50,000 acres showed evidence of defoliation from the air in 1957. However an egg survey conducted in October, 1957, showed a light overwintering population averaging less than 1 egg per 18-inch branch sample, compared with a high of 42 per sample in 1955. No serious defoliation is expected in 1958.—R. R. Lejeune.

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O. H. M. S.

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